Report
Of
Roger G. Morse AIA

On

ASTM
Microvacuuming
Dust Sampling Methods

October 17, 2005

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Report of Roger G. Morse A.I.A.

Qualifications

I am an architect licensed to practice architecture in a number of states and also an environmental consultant with many years of experience. A true and correct copy of my curriculum vitae is attached hereto and incorporated herein by reference.

I received my Bachelor of Science degree from Rensselaer Polytechnic Institute in 1970, and my Bachelor of Architecture in 1971 from the same institution.

I earned a license to practice architecture in 1976 after graduating from an accredited school of architecture, working under the direction of a licensed architect for at least three years and passing two batteries of tests, one lasting 5 days and one lasting 2 days. I am licensed to practice architecture in ten states and the District of Columbia. I hold certification by the National Council of Architectural Registration Boards, which allows for reciprocal licensing in many other states.

I am the President and Technical Director of Morse Zehnter Associates, a firm that provides consulting services in the fields of architecture, indoor air quality (IAQ), forensic investigations, HVAC Engineering and environmental issues in buildings, including specific services relative to asbestos, toxic materials, indoor air, industrial hygiene, environmental management, remediation, sampling and analysis of air and materials. Morse Zehnter Associates has offices located at 504 Snake Hill Road, Poestenkill, New York, 12140 and 2240 Palm Beach Lakes Boulevard, West Palm Beach, FL 33409.

I have been involved as an architect in the specialized area of asbestos evaluation and control since the late 1970's. I received specialized training in asbestos at the Page and William Black Post-Graduate School of Medicine of the Mount Sinai School of Medicine and the National Asbestos Training Centers at University of Kansas and Georgia Institute of Technology and hold accreditations in asbestos inspection, management planning and abatement design. Because of my expertise with respect to asbestos in buildings, I have served on a number of professional committees and panels concerned with asbestos issues. I have given presentations on environmental issues in the building industry to the American Institute of Architects, the American Society of Heating, Refrigerating and Air Conditioning Engineers, American Industrial Hygiene Association, International Facilities Managers Association, Building Owners and Managers Association, Environmental Information Association and many other organizations. I have developed courses on environmental issues in buildings and taught asbestos-related professional accreditation courses at a number of universities including Georgia Tech, the University of Kansas, the University of Illinois, Tufts University and the Environmental Institute. I have taught on the subject of dust sampling in asbestos courses.

I have served on the EPA's Science Advisory Board, the U.S. Department of Housing and Urban Development's Healthy Homes Initiative peer review panel, and several other EPA peer review committees, including panels on hazard assessment and operations and maintenance of buildings with asbestos-containing materials.

I was appointed as the representative of the architectural community to the committee that developed the AHERA regulation through the process of regulatory negotiation (RegNeg). As such, I am intimately familiar with the regulation and the circumstances of its development.

I was appointed to the Select Committee convened by the Environmental Protection Agency and National Bureau of Standards to develop the Transmission Electron Microscopy clearance protocol for the AHERA regulation. As such, I am intimately familiar with this method and the issues and circumstances surrounding its development.

I am a member of the American Society for Testing and Materials D22.07 Committee on Sampling and Analysis of Atmospheres, and I am currently the committee member responsible for preparing a draft of a guidance document covering the proper use of the data from the ASTM dust sampling methods.

I am the principal author of the National Institute of Building Sciences' "Asbestos Abatement and Management in Buildings, Model Guide Specification." During work on this document I developed work practices for removal of asbestos-containing fireproofing and acoustical plaster.

In the early 1990's, I served on the Literature Review Panel, a multidisciplinary group of internationally-recognized experts brought together by the EPA under the auspices of the Health Effects Institute – Asbestos Research ("HEI-AR"), Cambridge, Massachusetts, whose work resulted in the publication of "Asbestos in Public and Commercial Buildings: A Literature Review and Synthesis of Current Knowledge."

I have published articles and guidance documents on asbestos in buildings including the topic of maintaining asbestos in place as a response action. A list of my publications is included in my Vitae.

I am familiar with the published scientific and scholarly work concerning asbestos in place, the management thereof, the health effects thereof and related issues. I regularly keep abreast of developments in the field by annually attending and speaking at scientific meetings, which occur throughout the United States.

I have had and continue to have a research interest in the asbestos and non asbestos containing materials used in buildings, the inter-relationships between these materials and building systems, the effect that normal use and occupation of buildings has on these materials and relationships, and the effect that this use, or abuse, will have on the potential for human exposure to asbestos.

This report is based on my knowledge of the facts and on information available to me as of the date of this report. If additional relevant information becomes available I may amend or supplement my opinions appropriately.

I charge $300 per hour for my work as an expert in this case.

Summary of opinions

My opinions in this matter are summarized as follows:

- Asbestos is an inhalation hazard. It is thus necessary to measure asbestos concentrations in the **air** to determine if there is an exposure risk to persons in a building. The D 5755 dust sampling method does not measure air levels; instead it determines an index of surface concentrations. As such, the results of this method cannot be used to determine if there is an exposure risk from asbestos in the dust.
- Dust deposits in buildings are not uniform and vary widely in concentration and composition from location to location so that spatially distributed samples of the dust are not reproducible.
- There are uncontrolled sources of variation in the D 5755 dust sample collection process so that the sampling of building surfaces is not reproducible.
- The D 5755 sample preparation modifies the dust so that it is not possible to determine the nature of the dust. The size and nature of the asbestos particles is changed so that it is impossible to predict the potential that asbestos particles on a surface have for becoming airborne.

Asbestos is an Inhalation Hazard

Asbestos is an inhalation hazard. This means that health effects are due to

inhalation of airborne asbestos rather than contact with dust on surfaces. In order to demonstrate that a building occupant or worker is at a significant risk of disease from an asbestos-containing building material it is necessary to show that airborne asbestos levels exist, or will be generated by normal activities, at levels that can produce disease. The studies that associated disease with asbestos exposures were based either on air samples or epidemiological studies of environments that had elevated airborne concentrations of asbestos. Exposures known to cause disease were measured by methods that did not distinguish between asbestos and other fibers. The contemporary sampling method that comes closest to measuring exposures in the same manner as that used in the health effects studies is phase contrast microscopy (PCM) air sampling.

In order to estimate the potential of health effects it is necessary to determine the inhaled dose that occupants of a space or participants in an activity are likely to experience. The accepted way of determining this is to measure the airborne asbestos concentration in an area or the concentration that is generated in the breathing zone of an individual by an activity.

Air sampling is the accepted method for determining exposure to asbestos by governmental agencies and industrial hygienists. Health based standards, such as the OSHA asbestos standards, rely on air sampling to determine exposure to individuals.

The OSHA asbestos regulations[1] are health based standards and rely on air sampling. OSHA requires air sampling to determine exposures to workers. OSHA set a permissible exposure limit (PEL) expressed as an air concentration. Air sampling is required by the OSHA standards at the start of work, and periodically during work that disturbs asbestos containing materials.

Direct preparation air sampling is the methodology used by governmental agencies and others to determine asbestos exposures. OSHA uses air sampling to determine risk. EPA uses air sampling to allow re-occupancy after remediation[2]. The National Institute of Building Sciences (NIBS) uses air sampling to determine efficacy of operations and maintenance (O&M) controls[3]. In contrast, none of these

[1] US Department of Labor Occupational Safety and Health Administration (OSHA) 29 CFR 1910.1001, Occupational Exposure to Asbestos in General Industry, 29 CFR 1926.1101 Occupational Exposure to Asbestos in the Construction Industry, 29 CFR 1915.1001 Occupational Exposure to Asbestos in the Shipyard Industry.

[2] US EPA Asbestos Hazard Emergency Response Act (AHERA) regulation CFR 40, Part 763, Subpart E

[3] National Institute of Building Sciences (NIBS). Guidance Manual, Asbestos Operations & Maintenance Work Practices, Second Edition. December 1996

organizations requires the use of surface dust sampling or has adapted a surface dust standard for the purpose of assessing asbestos exposures or the risk of contracting asbestos related disease.

The ASTM D 5755 dust sampling method does not measure air concentrations of asbestos. As it involves an indirect sample preparation step it does not directly measure the concentration of asbestos on a surface. Instead it produces an index of the concentrations of asbestos in dust on surfaces. The method describes this limitation.

> 5.1 This microvacuum sampling and indirect analysis method is used for the general testing of non-airborne dust samples for asbestos. It is used to assist in the evaluation of dust that may be found on surfaces in buildings such as ceiling tiles, shelving, electrical components, duct work, carpet, etc. This test method provides an index of the surface loading of asbestos structures in the dust per unit area analyzed as derived from a quantitative TEM analysis. [4]

As the method states, the index reported is **not** a measure of air concentrations and no relationship has been established between this index and air measurements.

> 5.1.1 This test method does not describe procedures or techniques required to evaluate the safety or habitability of buildings with asbestos-containing materials, or compliance with federal, state, or local regulations or statutes. It is the user's responsibility to make these determinations.
> 5.1.2 At present, no relationship has been established between asbestos-containing dust as measured by this test method and potential human exposure to airborne asbestos. Accordingly, the users should consider other available information in their interpretation of the data obtained from this test method.[5]

Dust Loadings Vary Significantly From Place to Place in a Building

Dust sampling assumes that the nature and quantity of dust is uniform throughout the tested building. If this assumption is not made then a sampling plan must be developed to ascertain the gradations in dust levels and differences in dust types within the building.

An assumption that dust levels in a building are uniform is not generally valid. The

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[4] ASTM D 5755 Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Surface Loading. ASTM International. 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959.

[5] ASTM Standard Method D 5755 Op Sit.

quantity and nature of the dust that collects on surfaces in a building will vary greatly due to a number of factors.

- Dust samples are frequently collected in out of the way places such as the tops of ceilings or the tops of light fixtures. This is typically done without a determination that the cleaning history and age of the sampled surfaces is uniform. For example, if sampling is to be conducted on top of light fixtures, a replacement light fixture or one that has been relocated may have a different dust loading.
- Dust loadings are typically heavier near return air grills, adjacent to supply air grills and near windows. The heavier dust loading near windows is typically the result of infiltration of dust laden outside air rather than being a reflection of dust from inside the building.
- Paper dust loadings will typically be heavier in locations where paper is handled or processed such as near copy machines.
- Loading of dust comprised of skin flakes and fibers will typically be heavier in public assembly locations or in heavily occupied settings such as classrooms.
- The dust loading in return air spaces above suspended ceilings is typically variable with the dust loading becoming heavier where there is a change in direction of the return air or near collection points. Dust loading typically changes where the air velocity changes as return air moves around obstacles. There may be heavy dust loading in locations such as the intake into vertical chases where there may be turbulence.
- Obstructions in an air stream, such as the slats in a return air grill will generally have a higher dust loading than surrounding surfaces. The amount of dust collected on a grill will be affected by the volume and velocity of air flow, design of the grill, amount of turbulence, and amount of dust in the air stream. The type of dust (paper, biological, mineral) will depend upon the occupancy of the building and activity level.

The nature of the dust can also vary within a building depending upon the occupancy of the building, adjacency to highways, activities within the building and surface finishes in the building. The differences in the dust will affect the collection efficiency of the ASTM microvacuum dust sampling methods.

- Dust from highways or in high traffic areas can have a high soot and rubber dust content. This makes the dust sticky and difficult to collect using the microvacuum method. This dust may also contain asbestos from truck and automotive brakes.
- Paper dust may predominate in areas where paper is handled or processed. Paper dust is light and fluffy. When collected it tends to ball up and compress into pellets. If it becomes compressed during sampling it can become difficult to pick up uniformly. Heavy layers of paper dust can become felted and

difficult to pick up uniformly. If paper dust has been dry it is easily collected, but if it has become wet or has been affected by high humidity it can become difficult to collect efficiently by the microvacuum method.

- Collection of heavy dusts, such as mineral dusts, is typically less efficient than for light dusts such as paper.
- Soft dust particles are more likely to be ground up during the sampling process.
- Dust that has been wetted or affected by high humidity tends to adhere to the surface and reduce collection efficiency.
- The condition of the dust may vary considerably from location to location in the building. In some locations the dust may be light and fluffy and easy to collect. In other locations it may be crusty or stuck to the surface due to environmental conditions.

Commercial buildings are mechanically ventilated with air heated or cooled as necessary to maintain comfort conditions in the spaces of the building. The manner in which each air handling unit manages the air, the amount of outdoor air admitted by each unit, and the quality of filtration all influence the nature of the dust in the space. The circulation of air in the space affects the nature and distribution of dust in the space.

- Commercial air handling equipment brings in outside air to ventilate the building. The air that is delivered to a space thus contains some outside air and as such is more strongly influenced by dust in the outside air than is the air returning from the space. The dust in return air is more closely related to dust generating activities in the space. This means that the source of the dust collected in a surface dust sample is influenced by the location in a room from which the sample is collected. A sample collected on or in an area influenced by a supply air grill is dust from a different source than the dust on the return air grill or in the return air path.
- The operation of the ventilation system will change the composition of the dust in the space through time. Heavy particles will tend to fall to surfaces and remain in place while lighter particles will be carried out of the space on the return air stream.
- Pressure differentials developed by the ventilation system will affect the nature of dust in a space. If more supply air is provided to a space than return air is removed, the space will be positively pressurized and air will exfiltrate from the room to the outside and dust collected on window sills will be predominantly dust generated in the space. If the room is negative relative to outdoors then the dust on the window sills will be from infiltrating outside air. The dust from one space can be transferred to another in the building if there is a pressure differential between the spaces.

- The quality of maintenance can affect the nature of dust in the building. If filters are not maintained the amount of outdoor dust from ventilation air may increase. If equipment is not maintained rubber and hydrocarbon contamination from the equipment can affect the dust in the space. Much of the return air is filtered, heated or cooled and returned to the space. The quality of the filters in this air path will, in part, determine the nature and amount of particulate matter that is recirculated through the building.

The dust loading and nature of dust in a building will depend upon the age of the building and its components, the frequency and care of cleaning and the occupation of the building.

- A renovation in a building may result in newer, more dust free surfaces in one area of the building and dust migration from the renovation site to other areas.
- Areas that are cleaned by mopping will have lower dust loading than those that are vacuumed. Vacuum cleaners produce and distribute fine dust into the air that could settle on surfaces.
- Some areas of the building may be more frequently cleaned than others, leading to different dust loadings.
- Differences in occupation can lead to differences in the dust produced by the occupation. For example a classroom building may have office areas with a high concentration of paper dust, heavily populated classrooms resulting in a high concentration of skin flakes in the dust, and a kitchen where the dust is trapped in a layer of grease. The sample collection efficiency in these locations is likely to differ due to the differences in the dust.

The factors outlined above make the sampling of dust unreliable when a relatively small number of samples are collected. The normal operation of a building will cause considerable variations in the dust loadings that have settled on surfaces. The composition and nature of the dust will vary from place to place. This means that the quantity of dust collected will vary widely and unexpectedly from place to place. The only way to deal with this adequately is to take a sufficient number of samples to be able to describe the distribution of the dust in the building.

There Are Uncontrolled Sources of Variation in Sample Collection

In my experience the variability in sample results produced by the D 5755 dust sampling method is large. This causes difficulties in determining a correct index for the actual concentration of asbestos in the dust on surfaces. The method describes one source for this variability which is the differences in collection efficiency depending upon the surface that the sample is collected from.

> 1.2.1 This procedure uses a microvacuuming sampling technique. The collection efficiency of this technique is unknown and will vary among substrates. Properties influencing collection efficiency include surface texture, adhesiveness, electrostatic properties and other factors.[6]

The microvacuum collection technique will have a different collection efficiency depending upon the nature of the surface from which the dust is collected. For example the amount of dust collected from smooth hard surfaces will differ considerably from that collected from fabric[7]. However, the magnitude of the variations among the different types of surfaces that may be found in a building is unknown and uncharacterized. The collection efficiency from seemingly like surfaces will vary depending upon the static charge that is maintained by the surface.

There are other sources of variability not mentioned in the method including:

- The collection efficiency of the microvacuum collection procedure will vary with the angle of the nozzle. There is no way to control this angle, nor is there a standard for the angle. The size and weight of the dust particles collected by the microvacuum method depend on the speed of the air stream picking up the particles. The faster the air stream the heavier the particle that can be picked up. The speed of the air stream is determined by the volume of air being drawn and the size of the cross sectional area it is being drawn through. The larger the cross section the slower the air flow and the less efficient the dust collection. The angle of the nozzle will determine the cross section that air can pass through to get into the nozzle. As the nozzle is tipped back more of the nozzle tip is exposed and the air velocity goes down. As the nozzle is tipped up the space between the nozzle and surface becomes smaller and the air speed increases.
- The method is intended to consider only particles no larger than can fit through a 1mm screen. The sample collection procedure may process or change the dust as the nozzle is dragged back and forth through the dust. I have observed instances where soft crumbs of material larger than the 1 mm size restriction were broken up into small particles by the nozzle during sample collection. Thus, the microvacuum sample collection method could cause large particles of debris to be broken up so that they are analyzed as fine dust.

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[6] ASTM Standard Method D 5755 Op. Cit.

[7] Olcerst, R.B. Radiological Assessment of Surface Sampling Techniques. NAC Fall Technical Conference (Boston, MA) September 19, 1988

- A particle that can pass through a 1mm screen is big as compared to typical dust particles. A crumb of material this size, if it contained asbestos, could produce a vast number of small fibers after being processed by the indirect preparation procedure of the dust sampling method. The method makes note of this problem:

> 5.2 This definition of dust accepts all particles small enough to pass through a 1 mm (No. 18) screen. Thus, a single, large asbestos containing particle(s) (from the large end of the particle size distribution) dispersed during sample preparation may result in anomalously large asbestos surface loading results in the TEM analyses of that sample. It is, therefore, recommended that multiple independent samples are secured from the same area, and that a minimum of three samples be analyzed by the entire procedure. [8]

The variability of the results produced by the method is large. The source of the variability, whether it comes from the sampling, analysis or both is not known, making it difficult or impossible to control. The extent of variability cannot be predicted.

Sample Preparation Modifies the Dust and Results in Variability of Reported Fiber Counts

The ASTM D 5755 dust sampling method uses an indirect preparation method to analyze samples. The method itself admits that this changes the nature of the particles that are collected for analysis.

> 1.4.1 The procedure outlined in this test method employs an indirect sample preparation technique. It is intended to disperse aggregated asbestos into fundamental fibrils, fiber bundles, clusters, or matrices that can be more accurately quantified by transmission electron microscopy. However, as with all indirect sample preparation techniques, the asbestos observed for quantification may not represent the physical form of the asbestos as sampled. More specifically, the procedure described neither creates nor destroys asbestos, but it may alter the physical form of the mineral fibers.[9]

As I described previously, the composition of the dust in a building can vary widely. The indirect preparation procedures of ASTM D 5755 involve steps that can affect different types of dust in different ways, resulting in different reported counts of asbestos structures depending upon the other materials in the dust. Dusts that

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[8] ASTM Standard Method D 5755 Op. Cit

[9] ASTM Standard Method D 5755 Op. Cit

contain asbestos are likely to have different matrix materials depending upon their source. The reaction of these different matrix materials during indirect sample preparation produces populations of individual asbestos structures that are different from those that occurred in the dust on the surface[10]. There are obvious potential sources of bias in the method that could produce different fiber counts for different materials. These biases have not been studied, so at this point it is impossible to evaluate this source of variability as opposed to the variability introduced by different dust loadings and sample collection efficiencies.

In my experience the results from the dust sampling methods are typically small asbestos structures with individual fibers predominating. The particle sizes typically reported by the D 5755 dust sampling method are so small that if they actually existed in that form in the building they would stay airborne indefinitely rather than settle out as dust. This indicates that the procedures have modified the particle sizes so they are no longer the same as the particles of settled dust that were collected from the surface.

Attempts to Relate Surface Concentrations to Airborne Levels of Asbestos Are Problematic and Unproven

The ASTM D 5755 dust sampling method indicates that a relationship has not been established between the surface concentration of asbestos in dust and air concentrations.

> 5.1.2 At present, no relationship has been established between asbestos-containing dust as measured by this test method and potential human exposure to airborne asbestos. Accordingly, the users should consider other available information in their interpretation of the data obtained from this test method.[11]

Some investigators have attempted to determine a relationship between the results of surface sampling and airborne asbestos levels for a specific situation by taking dust samples and air samples of airborne concentrations generated by disturbance of the dust[12, 13]. Unfortunately, the air samples in these studies were analyzed by an

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[10] Chatfield, Eric J. Correlated Measurements of Airborne Asbestos-Containing Particles and Surface Dust. Published in STP 1342 Advances in Environmental Measurement Methods for Asbestos. Beard ME and Rook HL Editors. ASTM 1999

[11] ASTM Standard Method D 5755 Op Cit

[12] Ewing EM, Chesson J, Dawson TS, Ewing EM, Hatfield RL, Hays SM, Keyes DL, Longo WE, Millette JR, Spain WH. Asbestos Exposure During and Following Cable Installation In the Vicinity of Fireproofing. Appendix 1 in Settled Asbestos Dust Sampling and Analysis by Millette JR and Hays

indirect preparation method and no attempt was made to determine the extent to which this indirect preparation had changed the population of asbestos fibers that was reported. Other investigators have found that there is no correlation between concentrations of dust on surfaces and airborne levels generated by disturbance of the dust[14, 15]. One investigator has examined the difficulties in attempting to relate surface dust concentrations of asbestos to airborne asbestos levels[16] and found a number of problems, including:

- Indirect preparation methodology changes the nature and size of asbestos particles in the sample so that it is no longer the same as the dust that is on the surface. This makes it impossible to predict the aerodynamic capabilities of the dust, or the bond of the dust to its substrate. The indirect preparation method breaks down matrices, breaks down bundles and clumps, and may alter fibers (unravel large fibers or break long fibers into shorter pieces).
- The size and nature of asbestos particles are changed by the analysis so it is not possible to predict the potential of particles to become airborne if disturbed.
- The size and nature of asbestos particles is changed so it is not possible to predict the length of time that particles will remain airborne once entrained.
- Respirability of particles depends upon their size and geometry. The changes of particles due to indirect preparation make it impossible to predict the respirability of any entrained dust. This makes it impossible to predict the potential health effects of entrained dust.
- Surface dust in buildings consists of a mixture of particles and fibers. D5755 does not determine the composition, nature or sizes of particles in the dust that are associated with the asbestos particles. This makes it impossible to predict the capability of the dust to become airborne and the impact of environmental effects on the ability of the dust to become airborne.

SM. Lewis Publishers 1994.

[13] Keyes DL, Chesson J, Hays SM, Hatfield RL, Ewing WM, Longo WE, Millette JR. Re-entrainment of Asbestos from Dust in a Building with Acoustical Plaster. Appendix 8 in Settled Asbestos Dust Sampling and Analysis by Millette JR and Hays SM. Lewis Publishers 1994

[14] Lee RJ, Van Orden DR, Stewart IM. Dust and Airborne Concentrations – Is There a Correlation? Published in STP 1342 Advances in Environmental Measurement Methods for Asbestos. Beard ME and Rook HL Editors. ASTM 1999

[15] Fowler DP, Chatfield EJ. Surface Sampling for Asbestos Risk Assessment. Ann. Occup. Hyg., Vol. 41, Supplement 1, pp.279-286, 1997

[16] Chatfield, Eric J. Correlated Measurements of Airborne Asbestos-Containing Particles and Surface Dust. Published in STP 1342 Advances in Environmental Measurement Methods for Asbestos. Beard ME and Rook HL Editors. ASTM 1999

I have testified about the use of the ASTM dust sampling methods previously in Armstrong World Industries. My opinions remain the same as expressed in testimony in that matter and transcripts of that testimony may be referred to for additional information. I may offer further opinions, as necessary, to respond to views expressed by opposing experts.

Roger G. Morse

10/17/05
Date

Report of Roger G. Morse A.I.A.

Exhibits

ROGER G. MORSE, A.I.A.
CURRICULUM VITAE

Education

B. Arch., Rensselaer Polytechnic Institute, Troy, NY, 1971
B.S., Rensselaer Polytechnic Institute, Troy, NY, 1970

Specialized Training in Asbestos, Lead, and Mold in Buildings

Asbestos in Schools and Public Buildings, Page and William Black Post-Graduate School of Medicine of the Mount Sinai School of Medicine, 1984

Asbestos Inspector and Management Planner, National Asbestos Training Center, University of Kansas, 1988 w/annual refresher

Practices and Procedures for Asbestos Control, National Asbestos Training Center, University of Kansas, 1988 w/annual refresher

Respiratory Protection for the Asbestos Abatement Industry, Georgia Institute of Technology, 1989

Lead Inspector and Lead Risk Assessor, State University of New York at Buffalo, 2001 w/ tri-annual refresher

Mold Assessment and Remediation in Buildings, The Environmental Institute, 2001

WUFI-ORNL 3.3, WUFI-Pro3.3 and Weather Analyzer 1.0, Program for calculating coupled heat and moisture transfer in building components, Oak Ridge National Laboratory & Fraunhofer Institute of Building Physics, 2005

Current Professional Experience

Morse Zehnter Associates, Poestenkill, NY; West Palm Beach, FL 2003 - present
President. Formed as a division of Dyanki, Inc. to establish greater name recognition for the firm by incorporating the Principals' names.

Dyanki, Inc. Poestenkill, NY; West Palm Beach, FL 1998 - present
President. Architectural/Engineering/Industrial Hygiene practice focusing on, indoor air quality, indoor environmental quality, environmental issues in and exterior to buildings, forensic investigations, computer and web applications for building delivery and maintenance, construction management, materials and systems evaluation, design and construction contracts, failure analysis of building systems and materials, energy analyses, solar design and life-cycle cost analyses. Providing mechanical engineering services including specialized services in indoor air quality, humidity control and forensic analysis of HVAC systems. Specific services are provided relative to asbestos, mold, toxic materials, indoor air, material or system failures, architecture, engineering, industrial hygiene, environmental management and on-site analytical services.

Roger G. Morse Associates, Poestenkill, NY 1982 - present
Architectural practice focusing on the technical aspects of architecture including design /build, land use planning, site selection and evaluation, space planning and programming, design, budget analysis, preparation of contract documents, construction management. Design and monitoring of environmental remediation projects.

Previous Experience

Entek Environmental & Technical Services, Inc., Troy, NY 1985 - 1996
President. Environmental and technical consulting firm founded to provide services relative to environmental issues in and exterior to buildings. Specific services were provided relative to asbestos, toxic materials, indoor air, architecture, engineering, industrial hygiene, environmental management and analytical laboratory services.

Morse Ciraulo Associates, Troy, NY 1992 - 1996
Senior Partner. General architectural practice that also provided construction management, energy analyses, solar design life-cycle cost analyses and graphics services.

Previous Experience (Cont.)

Langer-Dion-Morse Associates, Troy, NY 1983 - 1990
Partner. Full partner of architectural firm providing general architecture services, cost estimating services, life-cycle analyses and energy analyses.

Dodge Chamberlin & Luzine Associates, Rensselaer, NY 1978 - 1982
Project Manager for architectural firm involved with many projects for 1980 Winter Olympics
at Lake Placid, NY and projects for schools including asbestos related and energy conservation projects.

Rensselaer County Bureau of Planning, Troy, NY 1973 - 1978
Served as Town Planner and County Architect.

Dodge Chamberlin Associates, Rensselaer, NY 1971 - 1973
Project Manager for school projects including design and construction of school facilities.

Myrick & Chevalier, East Greenbush, NY 1971
Designer, Draftsman.

State University Construction Fund, Albany, NY 1970 - 1971
Research Associate, Programming Associate.

Modular Structural Systems, Latham, NY 1969 - 1970
Designer/draftsman for pre-engineered metal buildings and other structures.

Rensselaer Polytechnic Institute, Troy, NY 1965 - 1971
Research Assistant, Paul Hartek Group. NASA sponsored
research of simulated atmospheres of earth & other planets.

Society Memberships

- American Institute of Architects
- American Industrial Hygiene Association
- American Conference of Governmental Industrial Hygienists
- International Society of Indoor Air Quality and Climate
- Environmental Information Association
- National Institute of Building Sciences
- Building Owners and Managers Association
- American Society of Heating, Refrigeration, and Air Conditioning Engineers
- American Society for Testing and Materials
- SSPC, The Society for Protective Coatings
- American Institute of Steel Construction
- Association of Iron and Steel Engineers
- National Association of Corrosion Engineers
- Photographic Society of America
- Society of Fire Protection Engineers
- American Society of Civil Engineers
- Council on Tall Buildings and Urban Habitat
- Construction Specifications Institute
- American Concrete Institute
- National Roofing Contractors Association
- International Code Council

Current & Past Appointments

National Institute of Building Sciences - Member, steering committee on Indoor Air Quality - Multiple Chemical Sensitivity, Chair subcommittee on Building Design, 2005 to present.

Current & Past Appointments (Cont.)

National Institute of Building Sciences - Member, Project Committee on Whole Building Design Guide, author of chapter on "Mold & Moisture Control in Building Envelopes," 2004 to present.

National Institute of Building Sciences - Member, Project Committee on "Guidelines for Total
Building Commissioning," 2004 to present.
Skyscraper Safety Campaign (SSC) - Technical Advisory Board, 2002 - present.

US Department of Housing and Urban Development (HUD). Peer review panel for HUD Healthy Homes Initiative, 1998-99.

US National CAD Standard (NCS) - Member, Project Committee, National Institute of Building Sciences, 1997 to present.

National Institute of Building Sciences - Consultant for 1996 revisions to "Guidance Manual:
Asbestos Operations & Maintenance Work Practices" and "Asbestos Abatement & Management In Buildings, Model Guide Specifications."

National Institute of Building Sciences - Joint venture with Leadtec to prepare "Lead Based
Paint Testing and Abatement Guide Specifications," 1994-1995.

National Institute of Building Sciences - Member, steering committee for project committee on "Lead-Based Paint O&M Work Practices Manual," 1993-1995.

American Society of Testing & Materials - Work group to develop "ASTM Standard Guide for Evaluation of Asbestos on Surfaces," 1993 to present.

U.S. EPA - member, Science Advisory Board on Indoor Air Quality and Total Human Exposure, 1992-1994.

National Asbestos Council - Chairman, Indoor Air Quality Task Force, 1992.

U.S. EPA - Technical advisor to Science Advisory Board on Indoor Air Quality and Total Human Exposure, 1992.

Environmental Safety Council of America - Co-chair, Indoor Air Quality Model Law Task Force, 1992-1993.

National Institute of Building Sciences - secretary, Project Committee on Asbestos Operations & Maintenance Work Practices, 1991-1992.

Health Effects Institute - Asbestos Research - member, Literature Review Panel,5/90 - 9/91 which produced the document: Asbestos in Public and Commercial Buildings: A Literature Review and Synthesis of Current Knowledge, 1991.

U.S. EPA Peer Review Committee for the document: Managing Asbestos In Place - A Building Owner's Guide to Operations and Maintenance Programs for Asbestos-Containing Materials (Green Book), 1990.

Association of Walls and Ceiling Institute - Asbestos Abatement Council, member, editorial review board for *Asbestos Abatement*, 1990.

American Society for Testing and Materials Committee D22.07 on Asbestos Sampling and Analysis, 1989 to present.

Roger G. Morse, AIA

Current & Past Appointments (Cont.)

National Asbestos Council - Member, Board of Directors and Board Liaison for Specification & Survey Committee, 1988 -1992.

U.S. EPA Committee - Asbestos in Public and Commercial Buildings Policy Dialogue Group, 1988.

U.S. EPA Peer Review Committee for the document: Evaluation of Asbestos Abatement Techniques - Phase 3: Removal, 1988.

U.S. EPA Peer Review Committee for AHERA Inspector/Management Planner Certification Course, 1987.

EPA/NBS Select Committee to develop the Transmission Electron Microscopy clearance protocol for the AHERA regulation, 1987.

Asbestos Hazard Emergency Response Act of 1986 (AHERA) official representative of the American Institute of Architects to the United States Environmental Protection Agency (U.S. EPA) Negotiated Rules Committee, 1987.

U.S. EPA Peer Review Committee for the document: Asbestos-in-Buildings Technical Bulletin: Removal Encapsulants, 1986.

U.S. EPA Peer Review Committee Panel for the Hazard Assessment Guidance Document,
1986.

U.S. EPA Peer Review Committee for the Operations and Maintenance Guidance Document,
1986.

Licensures

- Architectural Licenses in Arizona (12/89), California (1/88), Connecticut (4/84), District of Columbia (4/90), Florida (3/86), Georgia (5/02), Illinois (5/88), Indiana (3/88), Maryland (2/85), New Hampshire (1/89) (inactive), New York (9/76), Ohio (2/86) (inactive), Pennsylvania (12/83) (inactive), Rhode Island (9/87) (inactive) and South Carolina (7/90) (inactive)
- National Council of Architectural Registration Boards (12/83)

Asbestos & Lead Certifications

- Accredited as Asbestos Inspector and Management Planner as required by Asbestos Hazard Emergency Response Act (AHERA) through The National Asbestos Training Center, University of Kansas, certificate #VII KU86350-15
- Accredited as an Abatement Designer through the National Asbestos Training Center of the University of Kansas, certificate #VII KU85740
- New York State Asbestos Certificate #AH-88-06541 for Inspector, Management Planner, Project Designer and Project Supervisor
- Connecticut Asbestos Project Designer #000025
- Connecticut Asbestos Inspector/Management Planner #00023
- Connecticut Lead Inspector Risk Assessor #002125
- Florida Asbestos Consultant License #AF-0000003
- New York City Asbestos Investigator Certificate #75021
- US EPA / NY Lead Inspector Certificate NY-06-112004-789
- US EPA / NY Lead Risk Assessor Certificate NY-06-112004-790
- US EPA / FL Lead Inspector Certificate FL-05-122004-332
- US EPA / FL Lead Risk Assessor Certificate FL-05-122004-333
- New Hampshire Asbestos Certificate #057-ID (inactive)
- Vermont Asbestos Site Inspector Certificate #14807 (inactive)
- Vermont Asbestos Project Designer Certificate #14808 (inactive)
- Massachusetts Asbestos Inspector Certificate #02156 (inactive)
- Massachusetts Asbestos Project Designer Certificate #00839 (inactive)

Publications

Morse, Roger. Conference Proceedings, National Institute of Building Sciences / Building Environment and Thermal Envelope Council, M6: Mold, Moisture, Misery, Money and Myth – Plus Management, "The Second Phone Call," 2004.

Morse, Roger and Haas, Paul. Conference Proceedings, American Industrial Hygiene Conference & Expo. "Causes of High Relative Humidity Inside Air Conditioned Buildings," 2004.

Morse, Roger. Conference Proceedings, American Industrial Hygiene Conference & Expo. "Remediation of Mold Contaminated Fiberglass Lined Ductwork," 2004.

Morse, Roger. Conference Proceedings, American Industrial Hygiene Conference & Expo. "Effect of Air Transport Through Mold Contaminated Ductwork," 2003.

Morse, Roger. Conference Proceedings, National Institute of Building Sciences / Building Environment and Thermal Envelope Council, M4: Mold, Moisture, Misery and Money, "Discovery, Identification and Diagnosis of Mold," 2003.

Morse, Roger. "Fireproofing at the WTC Towers" Fire Engineering; Oct 2002; Vol 155 issue 10; 110-112.

Morse, Roger. Conference Proceedings, American Industrial Hygiene Conference & Expo. Mold Growth in HVAC Equipment and Ductwork, 2002.

Morse, Roger. Proceedings of the 2002 Annual Conference & Exhibition, Air & Waste Management Assn. Mold Growth Inside Air Conditioning Equipment, 2002.

Langer, A. M. and Morse, R. G "The World Trade Center Catastrophe: Was the Type of Spray Fire Proofing a Factor in the Collapse of the Twin Towers?" Indoor and Built Environment 2001; Vol 10, Part 6:350-360.

Morse, Roger. "Important Issues Regarding HVAC Systems and Mold" in *Mold Assessment and Remediation in Buildings* by The Environmental Institute, 2001.

Morse, Roger. "Building Operations & Maintenance to Minimize Moisture & Mold" in *Mold Assessment and Remediation in Buildings* by The Environmental Institute, 2001.

Morse, Roger. "HVAC Mold Remediation" in *Mold Assessment and Remediation in Buildings* by The Environmental Institute, 2001.

Morse, Roger. Conference Proceedings, American Industrial Hygiene Conference & Expo. Development of An Indoor Air Quality (IAQ) Management Program, 2001.

Morse, Roger. Conference Proceedings, American Industrial Hygiene Conference & Expo. Sampling and Characterizing Plaster, 2001.

National Institute of Building Sciences. Asbestos Abatement & Management In Buildings, Model Guide Specifications, 1986, 1988, 1996.

National Institute of Building Sciences. Guidance Manual: Asbestos Operations & Maintenance Work Practices, 1996.

Morse, Roger, Conference Proceedings, Lead-Tech '95, Arlington, VA, "New Tool Available for Reducing Lead-Based Paint Hazards," 1995.

National Institute of Building Sciences. Guide Specifications for Reducing Lead-Based Paint Hazards, 1995.

Van Orden, DR, Lee, RJ, Bishop, KM, Kahane, D, and Morse, RG. "Evaluation of Ambient Asbestos Concentrations in Buildings Following the Loma Prieta Earthquake." Regulatory Toxicology and Pharmacology 21, 117-122 (1995).

Publications Cont.)

Morse, Roger G. "Operations and Maintenance Practices Recommended by Regulatory Agencies." Appl. Occup. Environ. Hyg. (November 1994).

Morse, R.G. "Inspections Under AHERA." In *AHERA Compliance Manual,* edited by H. H. Danford. Center For Energy and Environmental Management, 1988.

Morse, R.G. "Assessing Response Actions and Preparing the Management Plan." In *AHERA Compliance Manual,* edited by H. H. Danford. Center For Energy and Environmental Management, 1988.
Morse, R.G. "Surveying For Asbestos." In *Practices & Procedures For Asbestos Control.* National Asbestos Training Center of University of Kansas, 1988.

Morse, R.G. "Contract Specifications." In *Practices & Procedures For Asbestos Control.* National Asbestos Training Center of University of Kansas, 1988.

National Asbestos Training Center of University of Kansas. Study Guide – Model Guide Specifications Course. 1987. Manual for training programs on preparation of contract documents using the NIBS Specifications conducted at the following EPA Training Centers:

- University of Kansas
- University of Illinois
- Georgia Tech Research Institute
- Tufts University

Sawyer, Robert N., MD and Morse Roger G., Inventory Process for Determining Asbestos Control Needs and Costs. Architecture. December 1986.

National Institute of Building Sciences. Model Guide Specifications, Asbestos Abatement In Buildings, 1986.

Morse, R. G. The Strip, A Handbook for Developers and Municipalities. Rensselaer County Bureau of Planning, 1976.

Morse, R. G. The Subdivision, A Handbook for Developers and Municipalities. Rensselaer County Bureau of Planning, 1975.

Lectures and Presentations

Presentations on Mold and Moisture Control:

- American Industrial Hygiene Association, AIHce, Anaheim, 2005: "What Makes Some Hotels Susceptible to Mold Growth" and "Methods for Assessing Moisture and Remediating Mold Contamination in HVAC Systems"
- National Institute of Building Sciences / Building Environment and Thermal Envelope Council, M6 "Mold, Moisture, Misery, Money and Myth – Plus Management," Chicago, 2004
- Connecticut River Valley, AIHA, 2003
- National Institute of Building Sciences / Building Environment and Thermal Envelope Council, M4 "Mold, Moisture, Misery and Money," Washington, 2003
- Environmental Information Association, Savannah, 2003
- Environmental Breakfast Club, 2003
- American Industrial Hygiene Association, AIHce, San Diego, 2002
- Air & Waste Management Association Annual Conference, 2002
- Environmental Breakfast Club, 2002
- American Industrial Hygiene Association, AIHce, New Orleans, 2001
- Gypsum Association, 2001

Lecture Faculty Member for The Environmental Institute course: "Mold Assessment and Remediation in Buildings"

Presentations on Fireproofing at World Trade Center:

- Environmental Information Association, 2002
- GA Environmental Protection Division, 2002
- Southeastern Regulators Conference, 2002

Lectures and Presentations (Cont.)

National Institute of Standards & Technology, 2002
Society of Fire Protective Engineers, 2002
ASTM Johnson Conference, 2002
NYC Dept of Buildings WTC Building Code Taskforce, 2002

Presentations on Indoor Air Quality before such groups as:
GSA Advocacy for Design Excellence, Salt Lake City, 2003
Air & Waste Management Association 95th Annual Conference & Exhibition, 2001
Gypsum Association, 2001
International Facilities Managers Conference, Orlando, FL, 2000
First Annual Indoor Air Quality Conference & Exposition, Tampa, FL, 1992
American Institute of Architects - Convention and Exposition

Presentations on lead control and effects before such groups as:
Lead Tech '95 Annual Conference
Midwest Conference on Lead Poisoning Issues (Sept 95)
National Lead Abatement Council 1995 Annual Conference
Florida Environmental and Asbestos Council 1995 Annual Conference
Construction Specifications Institute, Eastern New York Chapter
Lead Tech '94 Annual Conference

Lecture Faculty Member of the EPA National Asbestos Training Centers at University of Kansas

Advanced Topics Courses on Specifying Asbestos Abatement Projects at EPA National Training Centers:

- University of Kansas
- University of Illinois
- Georgia Tech Research Institute
- Tufts University

Presentations on asbestos control and effects before such groups as:
Georgia Environmental Information Association, 2001
American Industrial Hygiene Association, Orlando, 2000
Environmental Information Association (formerly National Asbestos Council)
Building Owners and Managers Association
American Institute of Architects
American Society of Heating, Refrigeration, and Air Conditioning Engineers
American Society of Safety Engineers
Association of Wall and Ceiling Industries Asbestos Abatement Council
Defense Research Institute
American Public Works Association
Society of Professional Engineers
Greater Kansas City Conference on Asbestos